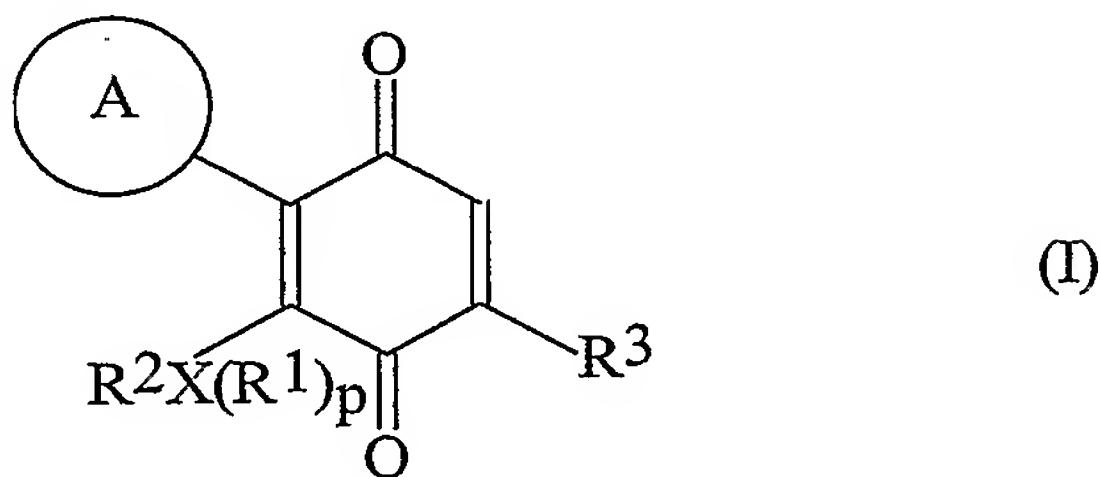


Claims:

1. A pharmaceutical composition comprising as active agent a cannabinoic quinone or an enantiomer thereof, wherein said cannabinoic quinone is a compound of the general formula (I):



wherein,

ring A is 5-, 6-, or 7-membered alicyclic or aromatic ring optionally substituted with from 1 to 3 substituents independently selected from optionally branched C₁-C₅ alkyl, optionally branched C₁-C₅ alkenyl, hydroxy, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino and cyano;

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

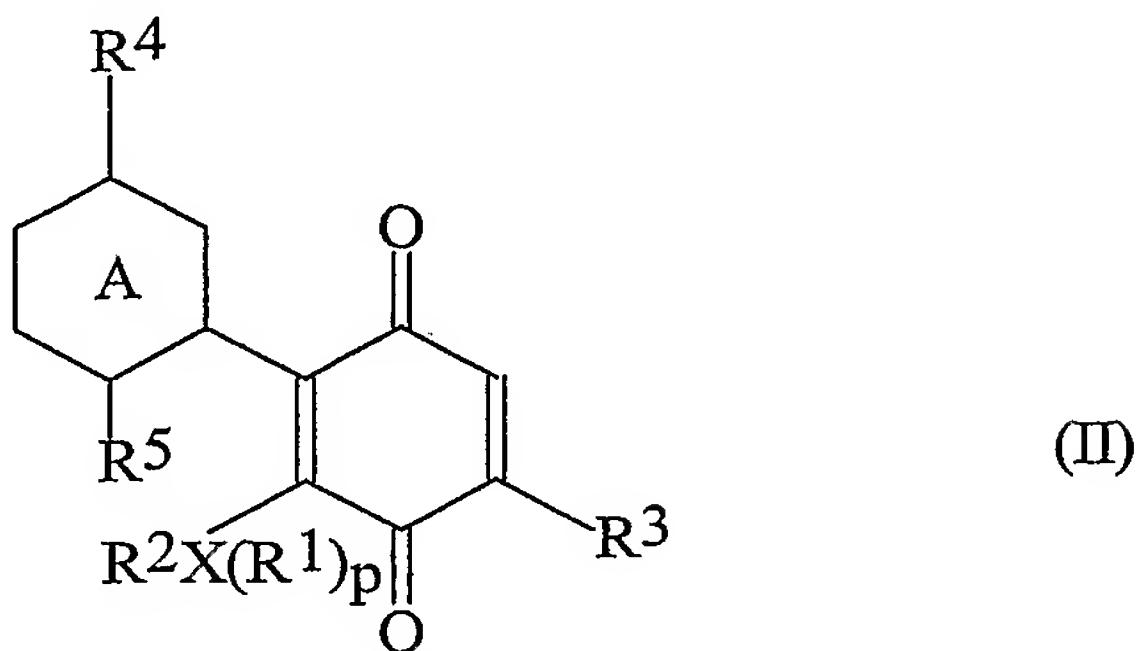
R¹ is H or C₁-C₅ alkyl;

R² designates a substituent selected from H and C₁-C₅ alkyl, or R² designates an optionally branched C₁-C₅ alkylene connected to ring A forming a 6-membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A;

R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

and optionally further comprising at least one pharmaceutically acceptable additive, diluent and/or carrier.

2. The pharmaceutical composition of claim 1, wherein said cannabinoic quinone is the compound of formula (II):



wherein

ring A is a cyclohexane, cyclohexene or benzene ring;

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

R² designates a substituent selected from H and C₁-C₅ alkyl, or R² designates an optionally branched C₁-C₅ alkylene connected to ring A forming a 6-membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A;

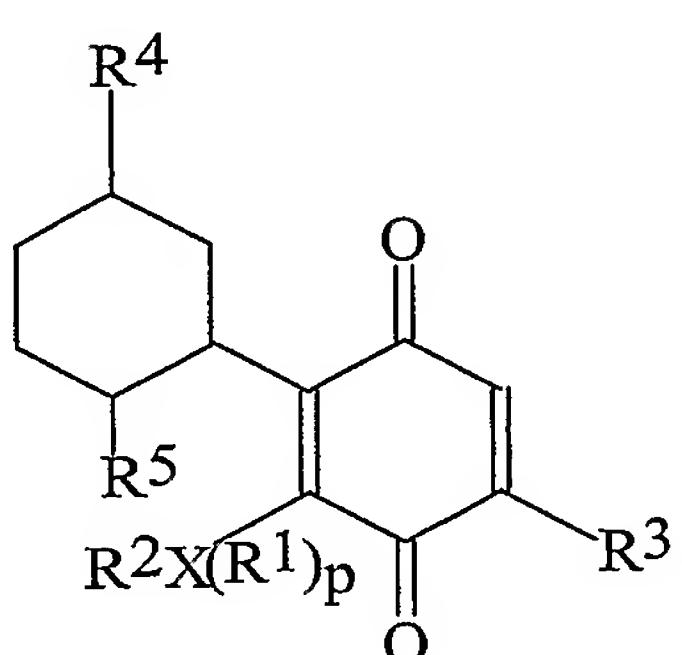
R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

R⁴ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano; and

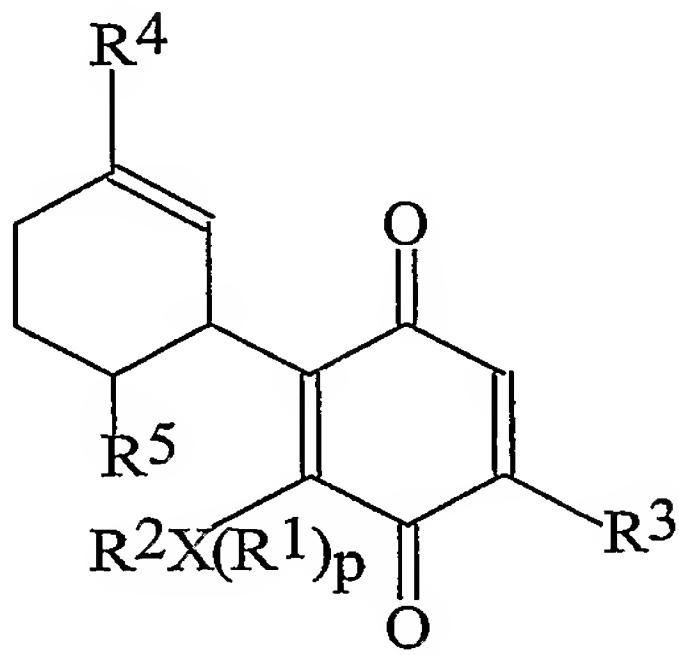
R⁵ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, or

R⁵ is hydrogen when R² is alkylene.

3. The pharmaceutical composition of any one of claims 1 and 2, wherein said cannabinoic quinone is a compound of one of formulae (III) or (IV), wherein formulae (III) and (IV) have the structure:



(III)



(IV)

wherein

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

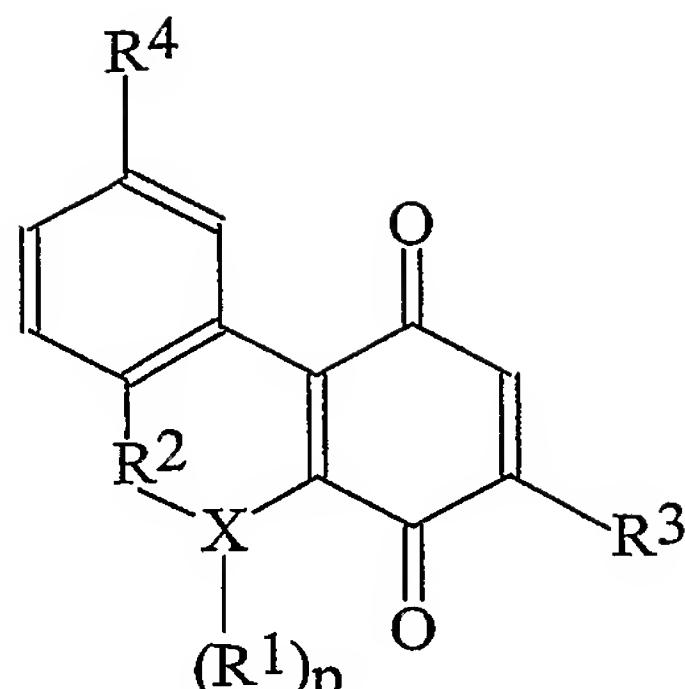
R^2 designates a substituent selected from H and C₁-C₅ alkyl;

R^3 is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano; and

R^4 is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano; and

R^5 is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl.

4. The pharmaceutical composition of any one of claims 1 and 2, wherein said cannabinoic quinone is a compound of formula (V):



wherein

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

R² designates a methylene group optionally substituted with up to two alkyl groups, wherein R² with the substituents comprises up to 5 carbon atoms;

R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano; and

R⁴ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano.

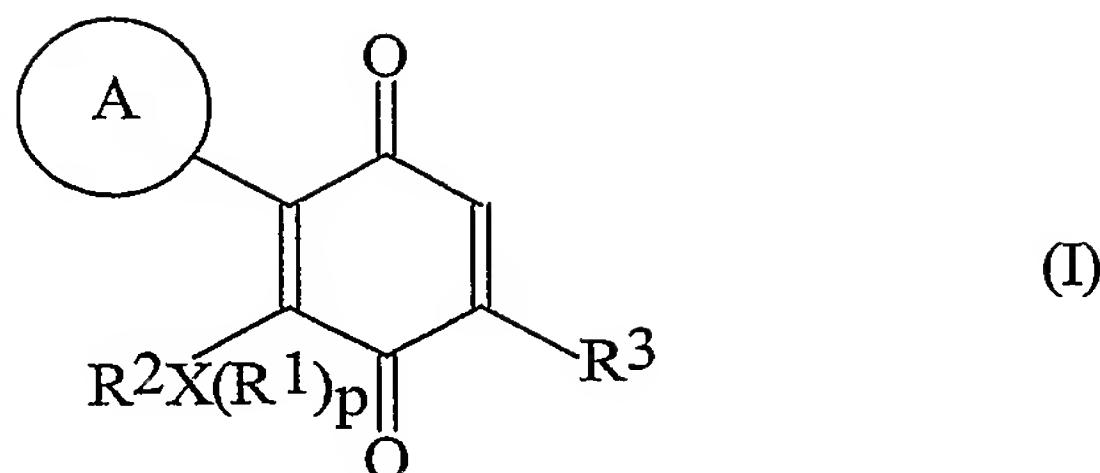
5. The pharmaceutical composition of any one of claims 1 to 3, wherein X is oxygen, R² is hydrogen, and R⁵ is 2-propyl or 2-propenyl.

6. The pharmaceutical composition of any one of claims 1 to 2 and 4, wherein X is an oxygen atom forming a pyrane ring comprising two carbon atoms of the quinone ring to which said oxygen is attached and carbon atoms 3 and 4 of ring A, which pyrane ring is preferably 2,2-dimethyl substituted.

7. The pharmaceutical composition of any one of claims 1 to 4, wherein R⁴ is methyl.

8. The pharmaceutical composition of any one of claims 1 to 2, wherein said cannabinoic quinone is the compound 3S,4R-p-benzoquinone-3-hydroxy-2-p-mentha-(1,8)-dien-3-yl-5-pentyl (also designated HU-331).
9. The pharmaceutical composition of any one of claims 1 to 2, wherein said cannabinoic quinone is the compound 6aR,10aR-1-H-dibenzo[b,d]pyran-1,4-(6H)-dione-6a β ,7,10,10a α -tetrahydro-6,6,9-trimethyl-3-pentyl (also designated HU-336).
10. The pharmaceutical composition of any one of claims 1 to 2 and 4, wherein said cannabinoic quinone is the compound 1-H-dibenzo[b,d]pyran-1,4(6H)-dione-6,6,9-trimethyl-3-pentyl (also designated HU-345).
11. The pharmaceutical composition of any one of claims 1 to 3, wherein said cannabinoic quinone is the compound 3S,4R-p-benzoquinone-3-hydroxy-2-[p-mentha-1-en-3-yl]-5-pentyl (also designated HU-395).
12. The pharmaceutical composition of any one of claims 1 to 3, wherein said cannabinoic quinone is the compound 3S,4R-p-benzoquinone-3-hydroxy-2-[p-menthan-3-yl]-5-pentyl (also designated HU-396).
13. The pharmaceutical composition of any one of the preceding claims, for the treatment of hyperproliferative disorders.
14. The pharmaceutical composition of claim 13, wherein said hyperproliferative disorder is a malignant or a non-malignant disorder.
15. The pharmaceutical composition of claim 13, wherein said hyperproliferative disorder is one of carcinoma, lymphoma, melanoma, glioblastoma and sarcoma.

16. The pharmaceutical composition of claim 14, wherein said non-malignant hyperproliferative disorder is psoriasis.
17. The pharmaceutical composition of any one of the preceding claims, for intra-peritoneal (i.p.), subcutaneous (s.c.) or intratumor administration.
18. The pharmaceutical composition of any one of claims 1 to 12, for the treatment of a disease or condition selected from inflammation and infections caused by bacteria, protozoa or fungus.
19. The pharmaceutical composition of any one of claims 1 to 12, for the treatment of an autoimmune disease.
20. The pharmaceutical composition of any one of the preceding claims, optionally further comprising pharmaceutically acceptable additives, diluents and carriers.
21. The pharmaceutical composition of claim 20, wherein said carrier is a 1:1:18 (v/v) mixture of ethanol:Emulphor®:PBS.
22. The pharmaceutical composition of any one of the preceding claims, wherein said active agent comprises an optically active isomer or a racemic mixture of said cannabinoic quinone.
23. A method for the treatment of a hyperproliferative disorder, comprising administering to a subject in need of treatment a therapeutically effective amount of a cannabinoic quinone of formula I:



wherein,

ring A is 5-, 6-, or 7-membered alicyclic or aromatic ring optionally substituted with from 1 to 3 substituents selected independently from optionally branched C₁-C₅ alkyl, optionally branched C₁-C₅ alkenyl, hydroxy, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

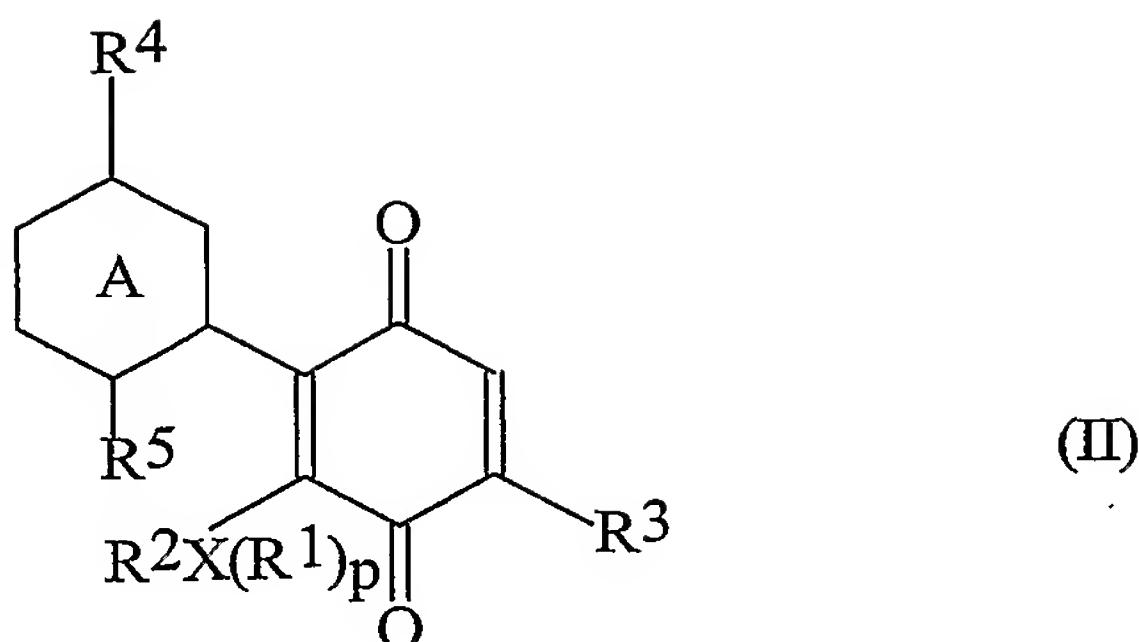
R¹ is H or C₁-C₅ alkyl;

R² designates a substituent selected from H and C₁-C₅ alkyl, or R² designates an optionally branched C₁-C₅ alkylene connected to ring A forming a 6-membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A; and

R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

or of a pharmaceutical composition as defined in any one of claims 1 to 17 and 20 to 22.

24. The method of claim 23, wherein said cannabinoic quinone is a compound of formula (II):



wherein,

ring A is a cyclohexane, cyclohexene or benzene ring;

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

R² designates a substituent selected from H and C₁-C₅ alkyl, or R² designates an optionally branched C₁-C₅ alkylene connected to ring A forming a 6-membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A;

R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

R⁴ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano; and

R⁵ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, or R⁵ is hydrogen when R² is alkylene.

25. The method of any one of claims 23-24, wherein said cannabinoic quinone is any one of HU-331, HU-336, HU-345, HU-395 and HU-396.

26. The method of treatment of any one of claims 23 to 25, wherein said hyperproliferative disorder is a malignant or a non-malignant disorder.

27. The method of treatment of any one of claims 23 to 25, wherein said hyperproliferative disorder is one of carcinoma, lymphoma, melanoma, glioblastoma and sarcoma.

28. The method of claim 27, wherein said cannabinoic quinone is one of HU-331, HU-395 and HU-396.

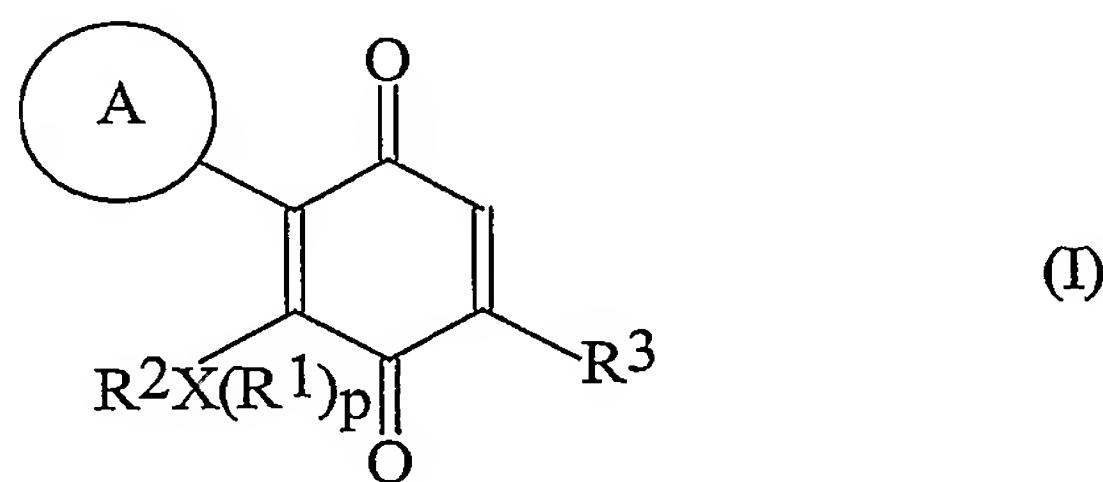
29. The method of claim 28, wherein said hyperproliferative disorder is one of colon cancer, lymphoma and breast cancer.

30. The method of claim 27, wherein said cannabinoic quinone is one of HU-336 and HU-345.

31. The method of claim 30, wherein said hyperproliferative disorder is one of prostate cancer and glioblastoma.

32. The method of any one of claims 23 to 31, wherein said cannabinoic quinone or composition comprising the same is administered via intraperitoneal, subcutaneous or intratumor route.

33. A method for the treatment of one of inflammatory, infectious and autoimmune conditions, comprising administering to a subject in need of such treatment a therapeutically effective amount of a cannabinoic quinone of general formula I :



wherein,

ring A is 5-, 6-, or 7-membered alicyclic or aromatic ring optionally substituted with from 1 to 3 substituents independently selected from optionally branched C₁-C₅ alkyl, optionally branched C₁-C₅ alkenyl, hydroxy, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

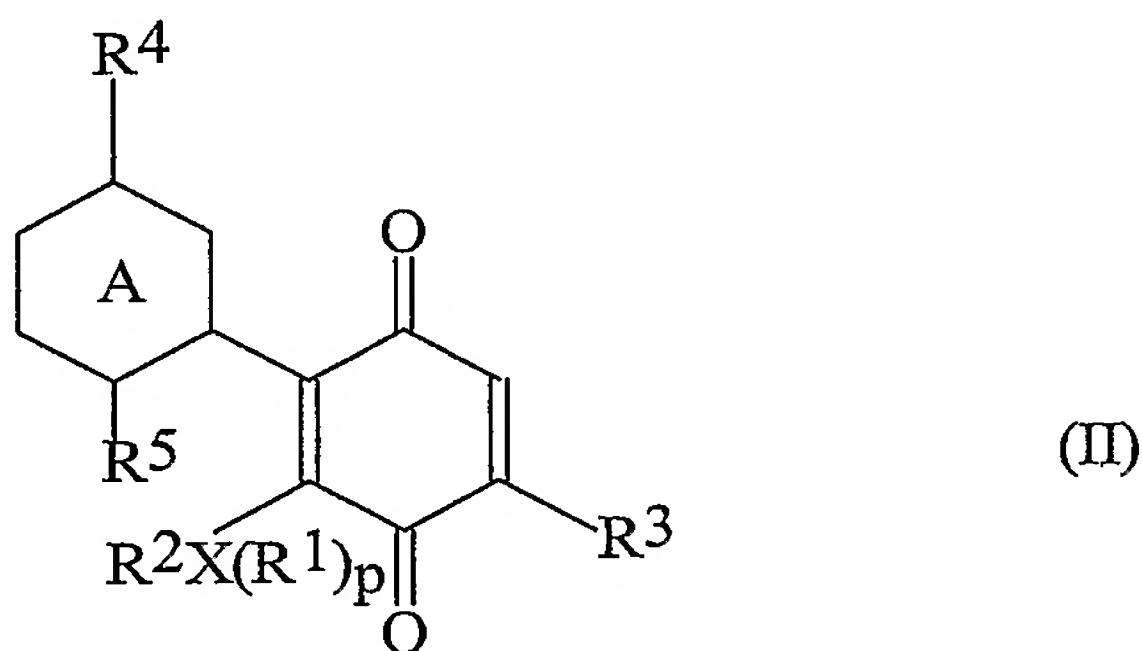
X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

R² designates a substituent selected from H and C₁-C₅ alkyl, or R² designates an optionally branched C₁-C₅ alkylene connected to ring A forming a 6-membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A; and R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano; or of a pharmaceutical composition as defined in any one of claims 1 to 12 and 18 to 22.

34. The method of claim 33, wherein said cannabinoic quinone is a compound of formula (II):



wherein

ring A is a cyclohexane, cyclohexene or benzene ring;

X is an oxygen, nitrogen or sulfur atom;

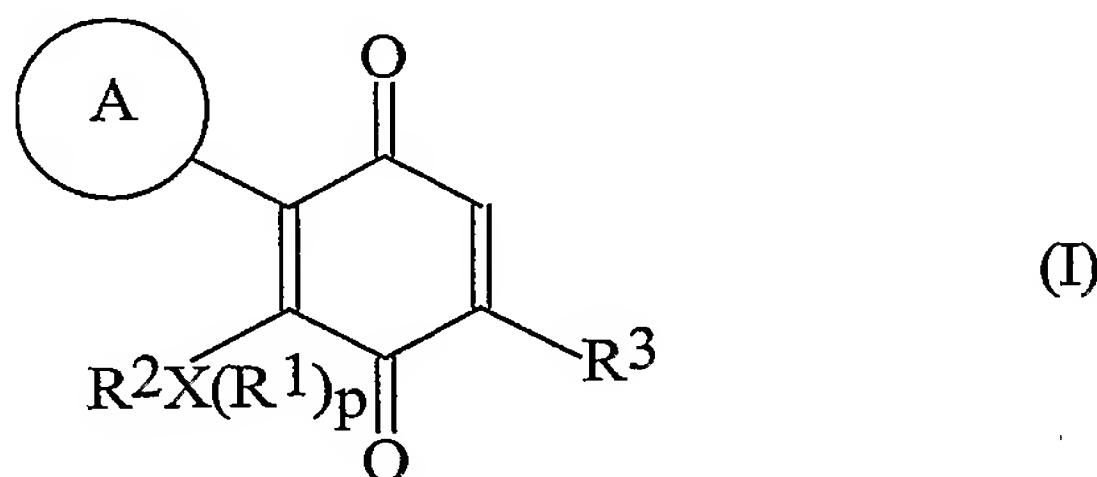
p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

R² designates a substituent selected from H and C₁-C₅ alkyl, or R² designates an optionally branched C₁-C₅ alkylene connected to ring A forming a 6-

membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A; R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano; R⁴ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano; and R⁵ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, or R⁵ is hydrogen when R² is alkylene.

35. Use of a cannabinoic quinone of formula I:



wherein,

ring A is 5-, 6-, or 7-membered alicyclic or aromatic ring optionally substituted with from 1 to 3 substituents independently selected from optionally branched C₁-C₅ alkyl, optionally branched C₁-C₅ alkenyl, hydroxy, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

X is an oxygen, nitrogen or sulfur atom;

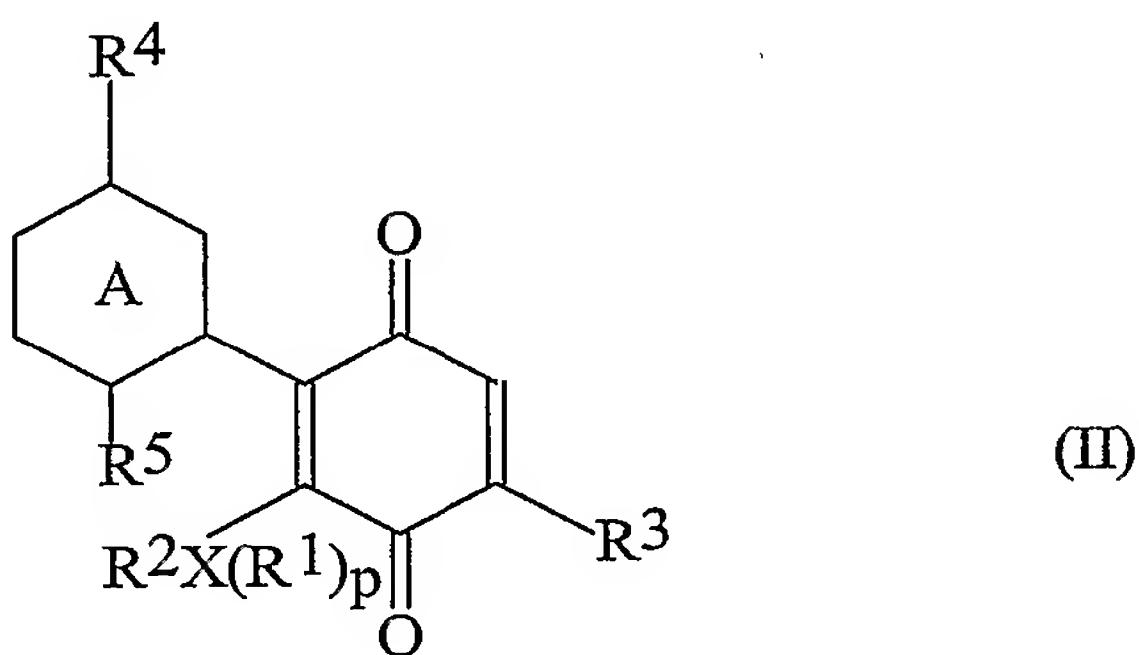
p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

R² designates a substituent selected from H and C₁-C₅ alkyl, or R² designates an optionally branched C₁-C₅ alkylene connected to ring A forming a 6-membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A; and

R^3 is optionally branched C_1-C_{10} alkyl or optionally branched C_1-C_{10} alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano; or any optically active isomer or racemic mixture of said cannabinoic quinone in the preparation of a medicament.

36. The use of claim 35, wherein said cannabinoic quinone is a compound of formula (II):



wherein

ring A is a cyclohexane, cyclohexene or benzene ring;

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R^1 is H or C_1-C_5 alkyl;

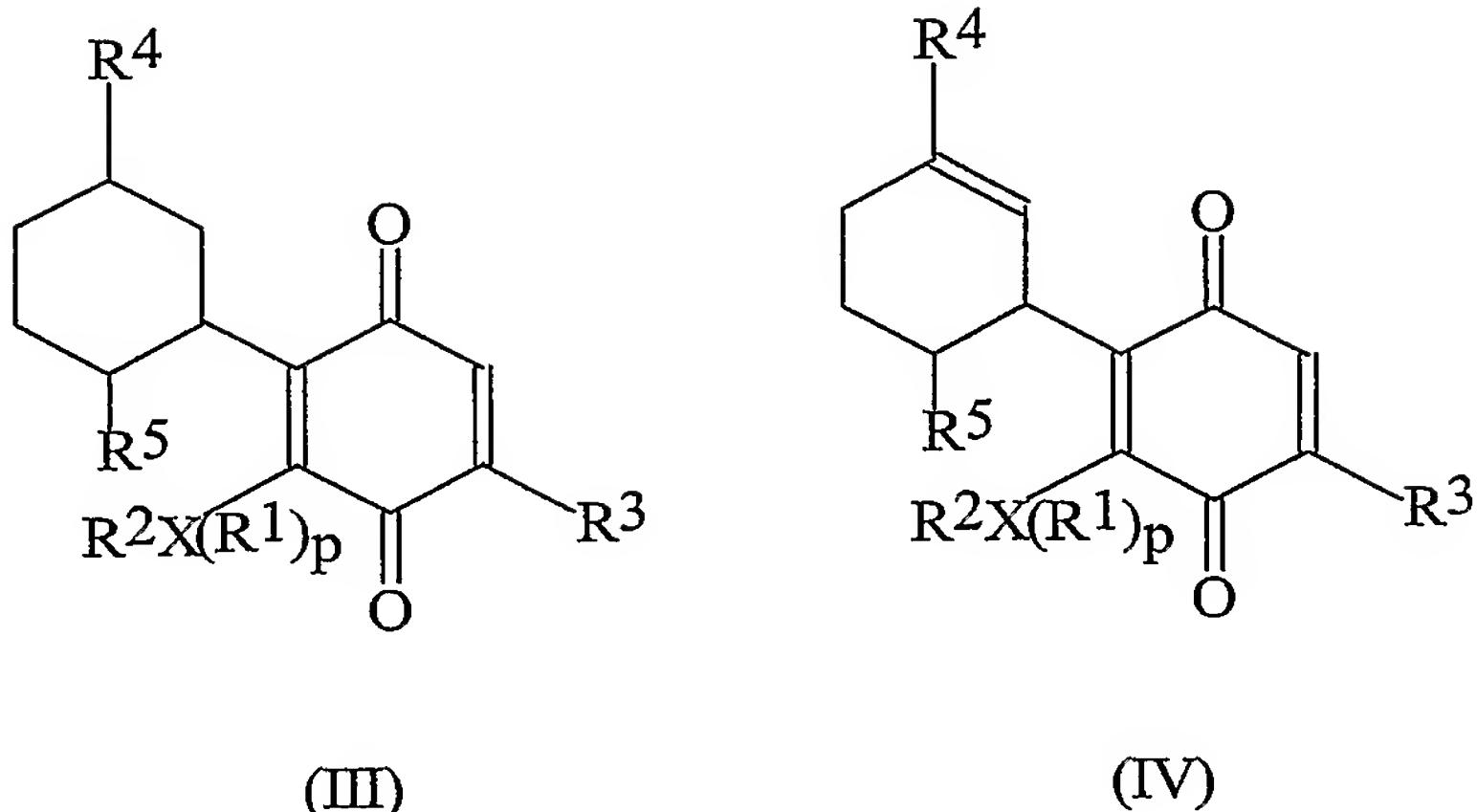
R^2 designates a substituent selected from H and C_1-C_5 alkyl, or R^2 designates an optionally branched C_1-C_5 alkylene connected to ring A forming a 6-membered heterocyclic ring comprising atom X, two carbon atoms of the quinone ring to which X is attached and carbon atoms 3 and 4 of ring A;

R^3 is optionally branched C_1-C_{10} alkyl or optionally branched C_1-C_{10} alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano;

R^4 is optionally branched C_1-C_5 alkyl or optionally branched C_1-C_5 alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano; and

R^5 is optionally branched C_1-C_5 alkyl or optionally branched C_1-C_5 alkenyl, or R^5 is hydrogen when R^2 is alkylene.

37. Use according to any one of claims 35 and 36, wherein said medicament is for the treatment of cancer.
38. Use according to any one of claims 35 and 36, wherein said medicament is for the treatment of one of an infectious disease, an inflammatory condition and an autoimmune disease.
39. The use of any one of claims 36 to 38, wherein said cannabinoic quinone is one of HU-331, HU-336, HU-345, HU-395 and HU-396.
40. The use of claim 39, wherein said cannabinoic quinone is HU-331.
41. Use of a cannabinoic quinone in the treatment of a hyperproliferative disorder.
42. The use of claim 41, wherein said cannabinoic quinone is one of HU-331, HU-336, HU-345, HU-395 and HU-396.
43. The use of claim 42, wherein said cannabinoic quinone is HU-331.
44. The use of any one of claims 41 to 43, wherein said hyperproliferative disorder is one of carcinoma, lymphoma, melanoma, glioblastoma, sarcoma and psoriasis.
45. The use of claim 44, wherein said hyperproliferative disorder is colon cancer or lymphoma.
46. A compound of formula (III) or (IV):



wherein

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

R¹ is H or C₁-C₅ alkyl;

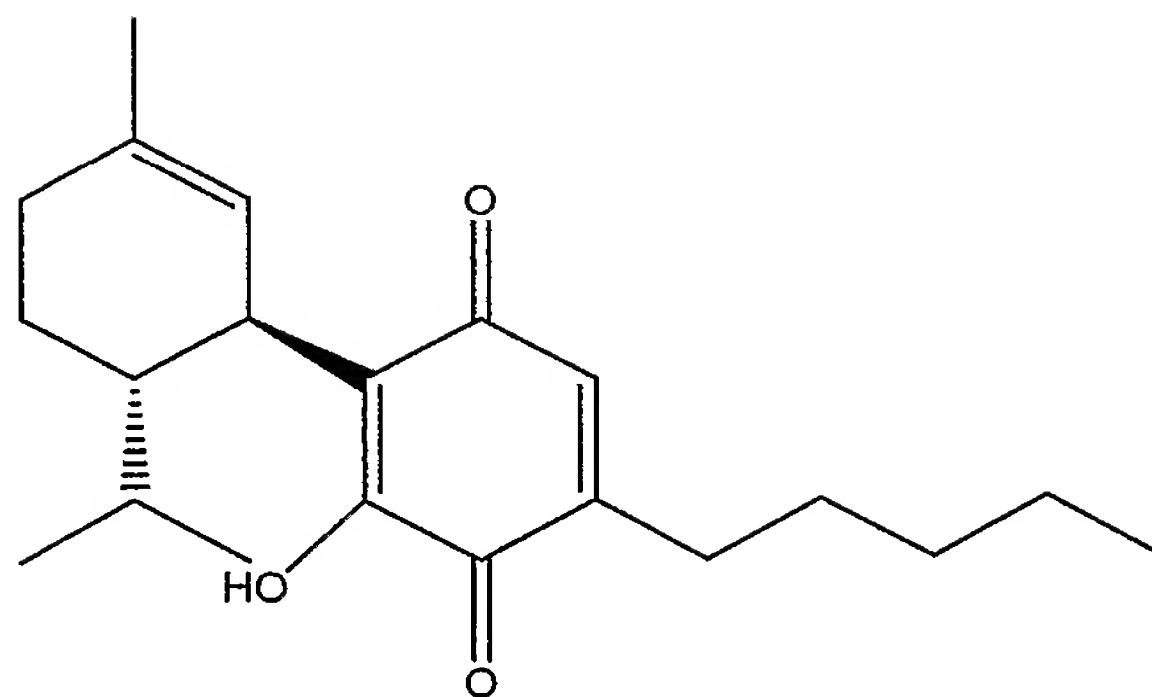
R² designates a substituent selected from H and C₁-C₅ alkyl;

R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano; and

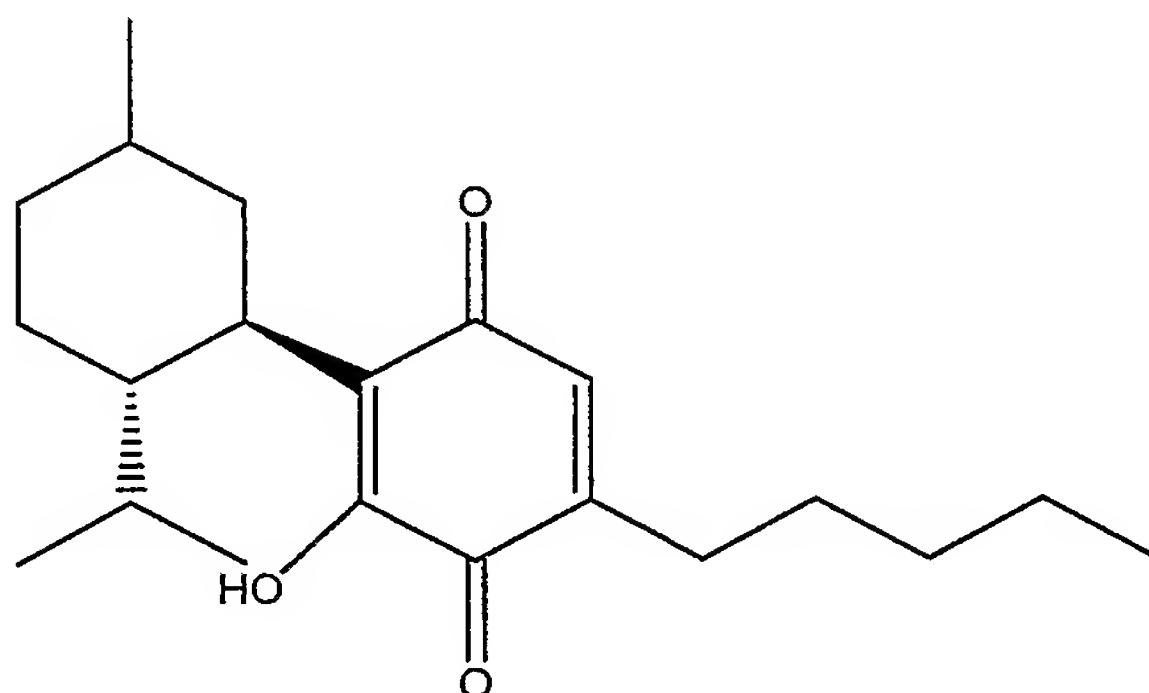
R⁴ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano; and

R⁵ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl.

47. The compound of claim 46, wherein said compound has one of the formulae:

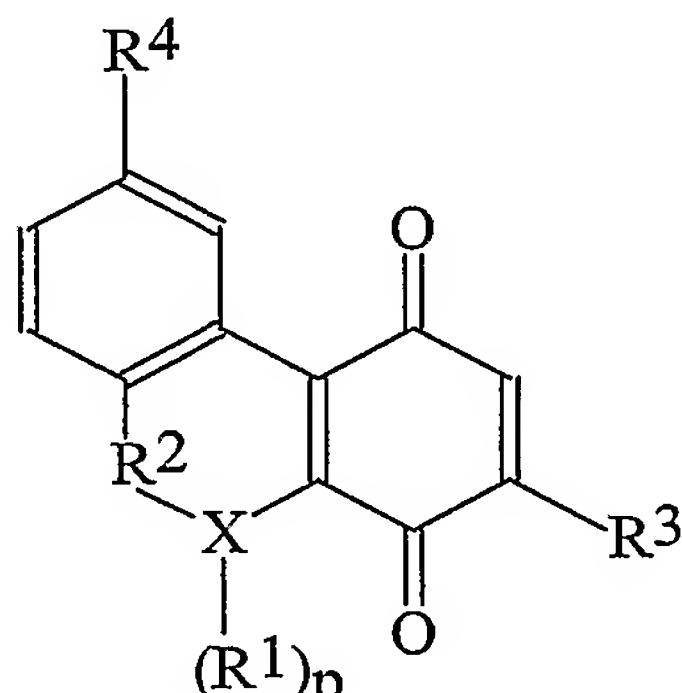


designated HU-395; or



designated HU-396.

48. A compound of formula (V):



(V)

wherein

X is an oxygen, nitrogen or sulfur atom;

p is zero when X is oxygen or sulfur, or p is 1 when X is nitrogen;

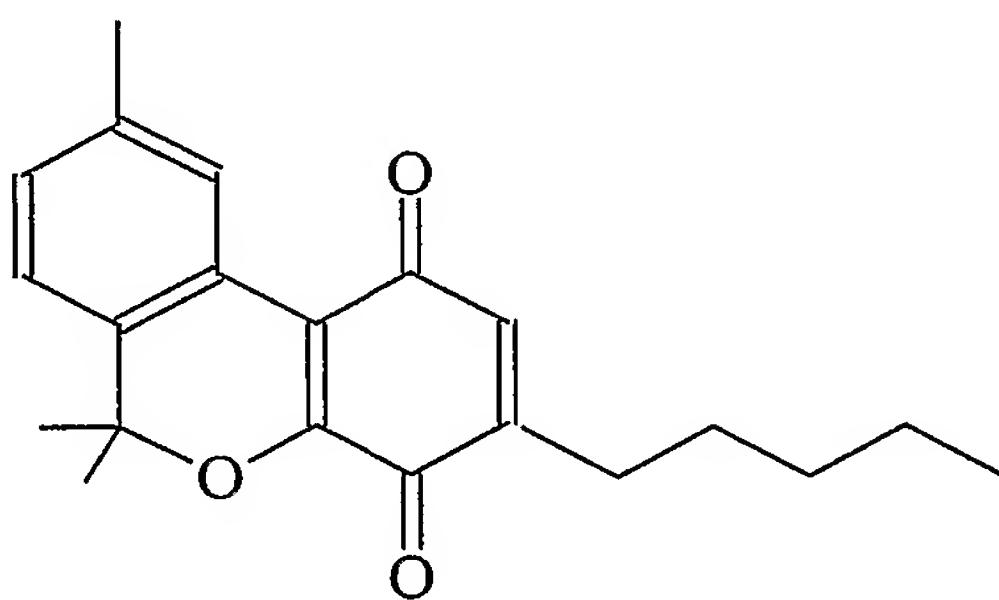
R¹ is H or C₁-C₅ alkyl;

R² designates a methylene group optionally substituted with up to two alkyl groups, wherein R² with the substituents comprises up to 5 carbon atoms;

R³ is optionally branched C₁-C₁₀ alkyl or optionally branched C₁-C₁₀ alkenyl, wherein said alkyl or alkenyl are optionally substituted with hydroxyl, alkoxy, halo (fluoro, chloro, bromo, iodo), thio, amino or cyano; and

R⁴ is optionally branched C₁-C₅ alkyl or optionally branched C₁-C₅ alkenyl, optionally substituted with hydroxyl, halo (fluoro, chloro, bromo, iodo) thio, amino and cyano.

49. The compound of claim 48, wherein said compound has the formula:



and is designated HU-345.

50. The optically active isomer and the racemic mixture of each of the compounds defined in claims 46-49.